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<b>UTILITY PATENT APPLICATION TRANSMITTAL</b> <small>(Only for new non-provisional applications under 37 CFR 1.53(b))</small>		Attorney Docket No. 93-0421.05	Total Pages	
First Named Inventor or Application Identifier Trung T. Doan				
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09/652969  
08/31/00

APPLICATION ELEMENTS <small>See MPEP chapter 600 concerning utility patent application contents.</small>		ADDRESS TO: Assistant Commissioner for Patents Box Patent Application Washington, DC 20231		
1. <input checked="" type="checkbox"/> Fee Transmittal Form <i>(Submit an original, and a duplicate for fee processing)</i>	6. <input type="checkbox"/> Microfiche Computer Program (Appendix)			
2. <input checked="" type="checkbox"/> Specification Total Pages <u>8</u> <i>(preferred arrangement set forth below)</i>	7. Nucleotide and/or Amino Acid Sequence Submission <i>(if applicable, all necessary)</i>			
-Descriptive -Cross References to Related Application -Statement Regarding Fed sponsored R & D -Reference to Microfiche Appendix -Background of the Invention -Brief Summary of the Invention -Brief Description of the Drawings <i>(if filed)</i> -Detailed Description -Claim(s) -Abstract of the Disclosure	a. <input type="checkbox"/> Computer Readable Copy b. <input type="checkbox"/> Paper Copy <i>(identical to computer copy)</i> c. <input type="checkbox"/> Statement verifying identity of above copies			
3. <input checked="" type="checkbox"/> Drawing(s) (35 USC 113) Total Sheets <u>2</u> Total Pages <u>6</u>	8. <input type="checkbox"/> Assignment Papers (cover sheet & document(s))			
4. Oath or Declaration	9. <input checked="" type="checkbox"/> 37 CFR 3.73(b) Statement <input checked="" type="checkbox"/> Power of Attorney <i>(where there is an assignee)</i>			
a. <input type="checkbox"/> Newly executed (original or copy)	10. <input type="checkbox"/> English Translation Document <i>(if applicable)</i>			
b. <input checked="" type="checkbox"/> Copy from a prior application (37CFR 1.63(d)) <i>(for continuation/divisional with Box 17 completed)[Note Box 5 below]</i>	11. <input type="checkbox"/> Information Disclosure Statement (IDS)/PTO-1449 <input type="checkbox"/> Copies of IDS Citations			
i. <input type="checkbox"/> <u>DELETION OF INVENTOR(S)</u> Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).	12. <input checked="" type="checkbox"/> Preliminary Amendment			
5. <input type="checkbox"/> Incorporation By Reference <i>(useable if Box 4b is checked)</i> The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.	13. <input checked="" type="checkbox"/> Return Receipt Postcard (MPEP 503) Small Entity <input type="checkbox"/> Statement filed in prior application Statement(s) Status still proper and desired			
17. <input type="checkbox"/> Continuation <input checked="" type="checkbox"/> Divisional	14. <input type="checkbox"/> Continuation-in-part (CIP) of prior application No. /			
18. CORRESPONDENCE ADDRESS				
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Trung T. Doan

§ Group Art Unit:

Serial No.:

§ Examiner:

Filed: August 31, 2000

§ Atty. Docket: 93-0421.05

For: CHEMICAL DISPENSING SYSTEM FOR  
SEMICONDUCTOR WAFER PROCESSING

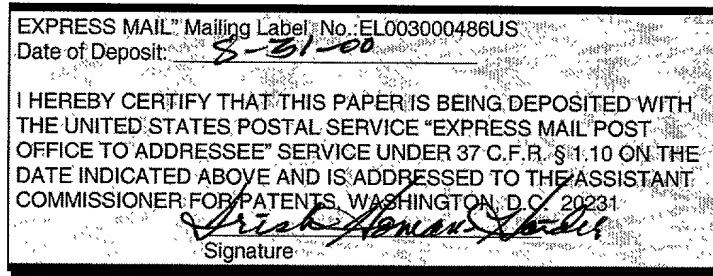
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PRELIMINARY AMENDMENT

Assistant Commissioner for Patents

Washington, D.C. 20231

Dear Sir:



After awarding the above-captioned application the benefit of the priority date of its great grandparent -- application #08/618,072, filed February 27, 1996 -- please amend the current application as follows.

IN THE SPECIFICATION:

Immediately after the title, please add the following: --

Related Applications

This application is a divisional of pending U.S. Application Ser. No. 09/133,989, filed Aug. 14, 1998; which is a continuation of U.S. Application Ser. No. 08/944,135, filed on Oct. 6, 1997 and issued as U.S. Patent No. 5,952,050; which is a continuation of U.S. Application Ser. No. 08/618,072, filed Feb. 27, 1996 and now abandoned.--

IN THE CLAIMS:

Please add the following claims:

12. A processor for a spin coating device including a chuck defining a wafer plane, comprising:
  - at least one dispenser; and
  - a suction mechanism generally around said at least one dispenser and offset from said wafer plane.
13. The processor in claim 12, wherein said at least one dispenser further comprises:
  - a first dispenser on a first side of said wafer plane; and
  - a second dispenser on a second side of said wafer plane.
14. A bead remover for a wafer having an edge, comprising:
  - a negative pressure mechanism configured to be spaced from said edge; and
  - a solvent-dispensing mechanism aligned with said negative pressure mechanism.
15. The bead remover of claim 14, wherein said solvent-dispensing mechanism is concentric to said negative pressure mechanism.
16. The bead remover of claim 15, wherein said solvent-dispensing mechanism is generally within said negative pressure mechanism.
17. An edge bead remover configured to service a spinning wafer, comprising:
  - a nozzle configured to apply a solvent to an edge of said wafer; and
  - a vacuum mechanism enveloping said nozzle and offset from a surface of said wafer.
18. The edge bead remover of claim 17, wherein said vacuum mechanism is configured to remove said solvent from said edge.

19. The edge bead remover of claim 18, wherein said vacuum mechanism envelopes said edge.
20. A material removal system for a wafer having an edge, comprising:  
a negative pressure device defining a vacuum area intersecting said edge; and  
a solvent dispenser intersecting said vacuum area.
21. The material removal system of claim 20, wherein said negative pressure device is distal from said edge.
22. An edge bead removal system for a wafer having an edge and a top and a bottom, comprising:  
a first solvent nozzle poised above said top of said wafer at said edge;  
a second solvent nozzle poised below said bottom of said wafer at said edge; and  
a suction device encompassing said first solvent nozzle and said second solvent nozzle.
23. The edge bead removal system in claim 22, wherein said suction device encompasses said top and said bottom of said wafer at said edge.
24. A chemical dispensing system for a workpiece, comprising:  
a negative pressure device defining a portal disposed toward and spaced from an edge of said workpiece; and  
a first solvent dispenser within said negative pressure device and disposed toward said edge.
25. The chemical dispensing system in claim 24, wherein said portal is spaced around said edge.

26. The chemical dispensing system in claim 25, further comprising a second solvent dispenser within said negative pressure device, disposed toward said edge, and opposing said first solvent dispenser.
27. The chemical dispensing system in claim 26, wherein said first solvent dispenser and said second solvent dispenser are within said portal.
28. A chemical remover for a substrate edge, comprising:  
a nozzle directed toward said substrate edge and configured to couple to a solvent source; and  
a vacuum device spaced from said substrate edge and directed toward said nozzle.
29. A profiler for a wafer edge, comprising:  
a solvent dispenser perpendicular to said wafer edge; and  
a solvent vacuumer surrounding at least a portion of said solvent dispenser and separate from said wafer edge.
30. The profiler in claim 29, wherein said solvent dispenser further comprises a location wherein solvent exits said solvent dispenser; and wherein said solvent vacuumer surrounds said location.
31. The profiler in claim 30, further comprising an additional solvent dispenser perpendicular to said wafer edge; wherein said solvent vacuumer surrounds at least a portion of said additional solvent dispenser.
32. The profiler in claim 31, wherein said solvent dispenser is disposed toward a top side of said wafer edge.
33. The profiler in claim 32, wherein said additional solvent dispenser is disposed toward a bottom side of said wafer edge.

34. A device for an edge bead, comprising:

a dispenser configured to release a chemical toward said edge bead; and  
a splash controller around said dispenser, physically unattached from said edge  
bead, and configured to draw said chemical toward said splash controller.

35. The device in claim 34, wherein said splash controller is configured to generate a gas  
pressure around said edge bead that is lower than an ambient gas pressure.

36. The device in claim 35, wherein said splash controller is configured to physically intercept  
said chemical.

37. The device in claim 36, wherein said splash controller is around said edge bead.

38. A removal system for a workpiece having an overlying material, comprising:

a nozzle having an extended position and a retracted position, wherein said nozzle  
is disposed toward said workpiece and configured to dispense a chemical toward  
said workpiece while in said extended position; and  
a suction applicator commensurately movable with said nozzle and defining a port  
around said nozzle, wherein said suction applicator is configured to withdraw said  
chemical and said material at a distance from said workpiece.

39. The removal system in claim 38, wherein said nozzle is further configured to dispense said  
chemical toward said material.

40. The removal system in claim 38, wherein said nozzle is further configured to dispense said  
chemical toward a portion of said workpiece interposed between said nozzle and said material.

Please cancel claims 1-37 without prejudice.

REMARKS

Claims 38-40 are the only claims pending as of this Preliminary Amendment. In a restriction requirement issued as part of the Office Action of March 21, 2000 during prosecution of the parent application, the Examiner identified these claims as "Group III" claims "drawn to a movable dispenser/ movable suction device, classified in class 118, subclass 323." If there are any matters which may be resolved or clarified through a telephone interview, the Examiner is requested to contact Applicants' undersigned attorney at the number indicated.

Respectfully submitted,

Date: 8/26/00

  
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ATTORNEY FOR APPLICANTS

## CHEMICAL DISPENSING SYSTEM FOR SEMICONDUCTOR WAFER PROCESSING

### FIELD OF THE INVENTION

The invention relates generally to the manufacture of semiconductor devices. More particularly, the invention relates to a chemical dispensing system for semiconductor wafer processes such as removing the edge bead formed during spin coating processes.

5

### BACKGROUND OF THE INVENTION

Coating materials such as photoresist are typically applied to a semiconductor wafer by flowing liquid coating material onto the top surface of the wafer while it is spinning. The wafer is held on a disk shaped, rotating spin chuck. The diameter of the chuck is slightly less than the diameter of the wafer. The chuck is positioned so that the wafer lies on the chuck in a level horizontal plane. In operation, the backside or inactive surface of the wafer is placed onto the chuck. The chuck applies a suction to the backside of the wafer to hold the wafer in place on the chuck. The chuck is rotated by a motor driven axle that extends down from the chuck. As the wafer is rotated on the chuck, liquid photoresist material is applied to the center of the wafer. The photoresist spreads radially outward from the center of the wafer towards the edge to coat the top of the wafer. Ideally, all excess coating material is ejected from the edge of the wafer. In practice, however, some excess photoresist tends to collect at and form a bead along the edge of the wafer.

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A solvent is dispensed along the edge of the wafer to dissolve the edge bead and remove the resist from the extreme edge of the wafer. The solvent may be dispensed through a nozzle directed toward the backside edge of the wafer, in which case it curls up around to the top of the wafer to dissolve the edge bead, or the solvent may be dispensed directly onto the top edge of the wafer. In either

case, the process allows solvent and dissolved photoresist to be splashed about and often leaves a jagged edge profile on the photoresist or other coating material.

#### SUMMARY OF THE INVENTION

Accordingly, it is one object of the invention generally to increase the

5 effectiveness of conventional edge bead removal systems. It is another object to control solvent and particle splashing during the process of removing the edge bead from the coating material. It is a further object of the invention to improve the edge profile of the coating material. These and other objects and advantages may be achieved in general by a method for dispensing a chemical, such as an edge  
10 bead removal solvent, onto a semiconductor wafer. The method comprises the steps of dispensing the chemical selectively onto the wafer and applying a suction to the area immediately surrounding the location at which the chemical is dispensed onto the wafer. Preferably, the suction is applied substantially simultaneously with the dispensing of the chemical.

15 One specific version of the invention provides an edge bead removal system wherein suction is applied to the area immediately surrounding the solvent dispensing nozzle to remove dissolved coating material and excess solvent from the wafer. In one aspect of this system, an apparatus for removing the edge bead includes a mechanism for dispensing a solvent selectively onto the edge of the  
20 wafer, and a mechanism surrounding the dispensing mechanism for vacuuming excess solvent and dissolved coating material from the edge of the wafer. The edge bead removal apparatus preferably also includes mechanisms for spinning the semiconductor wafer and coating material on the spinning wafer. Another aspect of the system provides a method for removing an edge bead of a coating of  
25 material that has been spun onto the surface of a semiconductor wafer. The method includes the steps of dispensing a solvent selectively onto the edge of the wafer to dissolve the coating material at the extreme edge of the wafer, and applying a suction to vacuum excess solvent and dissolved coating material from

the wafer. Preferably, the suction is applied to the area immediately surrounding the location at which the solvent is dispensed onto the wafer simultaneously with the dispensing of the solvent.

#### DESCRIPTION OF THE DRAWINGS

5 Fig. 1 is a partial side view of a spin coating device having the surrounding suction of the present invention wherein the edge bead removal solvent is dispensed onto the top of the wafer.

Fig. 2 is a partial side view of a spin coating device having the surrounding suction of the present invention wherein the edge bead removal solvent is dispensed onto both the top and bottom of the wafer.

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#### DETAILED DESCRIPTION OF THE INVENTION

Referring to Fig. 1, wafer 10 is positioned on spin chuck 12. Spin chuck 12 is mounted on axle 14. Axle 14 is operatively coupled to a drive mechanism, such as an electric motor (not shown). The diameter of spin chuck 12 is less than the diameter of wafer 10 so that wafer 10 extends beyond the edge of spin chuck 12. A first nozzle 15 for dispensing coating material onto wafer 10 is positioned above and, typically, at the center of wafer 10. A second nozzle 16 for dispensing solvent to dissolve the edge bead is disposed above the edge of wafer 10. Solvent dispensing nozzle 16 is surrounded by vacuum port 18. Vacuum port 18 is operatively coupled to a source of negative pressure, such as a vacuum pump (not shown).

In operation, a suction is applied to the wafer 10 to hold it in place on spin chuck 12. Spin chuck 12 is rotated to spin wafer 10 as a solution of coating material, such as photoresist, is applied through first nozzle 15. Although 25 photoresist is used herein as one illustrative coating, the invention is applicable to any soluble coating. The coating material is distributed across the top surface of wafer 10 largely due to centrifugal forces created by the spinning wafer. Excess

coating material tends to collect at and form a bead along the edge 22 of wafer 10. To remove the edge bead, a solvent is sprayed through nozzle 16 onto the edge 22 of wafer 10 to dissolve the coating material at the extreme edge of the wafer. At the same time, the dissolved coating material and excess solvent is suctioned away 5 from wafer 10 through vacuum port 18. Preferably, vacuum port 18 surrounds nozzle 16 and a suction is thereby applied to the area immediately surrounding nozzle 16, as shown in Fig. 1. Also, vacuum port 18 preferably moves with nozzle 16 as it is extended and retracted into position over wafer 10. This "surround 10 vacuum" controls solvent and particle splashing during the process of removing the edge bead from the coating material. In addition, it is believed the surround vacuum improves the edge profile of the coating material.

Fig. 2 illustrates a second embodiment of the invention wherein the solvent is applied to both the top and bottom surfaces of wafer 10. Wafer 10 is positioned on spin chuck 12 which is rotated on axle 14. An edge bead removal solvent is 15 supplied through tubes 20 to dispensing nozzles 16. The solvent is sprayed through nozzles 16 onto the edge 22 of wafer 10 and, at the same time, the dissolved coating material and excess solvent is suctioned away through vacuum ports 18.

Conventional spin coating machines, such as a SVG Coat Track or TEL Mark 20 8, can be adapted for use in accordance with the invention as described herein. With the exception of the vacuum ports, the above described components are conventional and well known to those skilled in the art. There has been shown and described an edge bead removal system wherein a suction is applied to the area surrounding the solvent dispensing nozzle to control splashing and improve the 25 edge profile of the coating material. The particular embodiments shown and described herein are for purposes of example and should not be construed to limit the invention as set forth in the appended claims.

CLAIMS

What is claimed is:

- 1 1. An apparatus for removing an edge bead of a coating of material that has  
2 been spun onto the surface of a semiconductor wafer, the apparatus comprising:  
3       a. means for dispensing a solvent selectively onto the edge of the wafer;  
4 and  
5       b. means surrounding the dispensing means for vacuuming excess  
6 solvent and dissolved coating material from the edge of the wafer.
  
- 1 2. An apparatus according to Claim 1, wherein the dispensing means is a  
2 nozzle and the vacuuming means comprises a vacuum port surrounding the nozzle.
  
- 1 3. An apparatus according to Claim 1, further comprising:  
2       a. means for spinning the semiconductor wafer; and  
3       b. means for applying a coating material to the spinning wafer.
  
- 1 4. A method for removing an edge bead of a coating of material that has been  
2 spun onto the surface of a semiconductor wafer, the method comprising the steps  
3 of:  
4       a. dispensing a solvent selectively onto the edge of the wafer to dissolve  
5 the coating material at the extreme edge of the wafer; and  
6       b. applying a suction to vacuum excess solvent and dissolved coating  
7 material from the edge of the wafer.
  
- 1 5. A method according to Claim 4, wherein the suction is applied to an area  
2 immediately surrounding a location at which the solvent is dispensed onto the  
3 wafer.

1    6.    A method according to Claim 4, wherein the step of vacuuming is performed  
2    substantially simultaneously with the step of dispensing.

1    7.    A method for spin coating a semiconductor wafer with a soluble material,  
2    comprising the steps of:  
3        a.    spinning the semiconductor wafer;  
4        b.    applying a coating material to the spinning wafer;  
5        c.    dispensing a solvent selectively onto the edge of the wafer to dissolve  
6    the coating material at the extreme edge of the wafer; and  
7        d.    applying a suction to the edge of the wafer to vacuum excess solvent  
8    and dissolved coating material from the edge of the wafer.

1    8.    A method according to Claim 7, wherein the suction is applied to an area  
2    immediately surrounding a location at which the solvent is dispensed onto the  
3    wafer.

1    9.    A method according to Claim 7, wherein the step of dispensing the solvent  
2    is performed substantially simultaneously with the step of applying a suction.

1    10.   A method for dispensing a chemical onto a semiconductor wafer, comprising  
2    the steps of:  
3        a.    dispensing the chemical selectively onto the wafer; and  
4        b.    applying a suction to an area immediately surrounding a location at  
5    which the chemical is dispensed onto the wafer.

1    11.   A method according to Claim 10, wherein the suction is applied substantially  
2    simultaneously with the dispensing of the chemical.

ABSTRACT

A method for dispensing a chemical, such as an edge bead removal solvent, onto a semiconductor wafer comprising the steps of dispensing the chemical selectively onto the wafer and applying a suction to the area immediately surrounding the location at which the chemical is dispensed onto the wafer.

- 5 Preferably, the suction is applied substantially simultaneously with the dispensing of the chemical. One specific version of the invention provides an edge bead removal system wherein suction is applied to the area immediately surrounding the solvent dispensing nozzle to remove dissolved coating material and excess solvent from the wafer. In one aspect of this system, an apparatus for removing the edge  
10 bead includes a mechanism for dispensing a solvent selectively onto the edge of the wafer, and a mechanism surrounding the dispensing mechanism for vacuuming excess solvent and dissolved coating material from the edge of the wafer. The edge bead removal apparatus preferably also includes mechanisms for spinning the semiconductor wafer and coating material on the spinning wafer. Another aspect  
15 of the system provides a method for removing an edge bead of a coating of material that has been spun onto the surface of a semiconductor wafer. The method includes the steps of dispensing a solvent selectively onto the edge of the wafer to dissolve the coating material at the extreme edge of the wafer, and applying a suction to vacuum excess solvent and dissolved coating material from  
20 the wafer.

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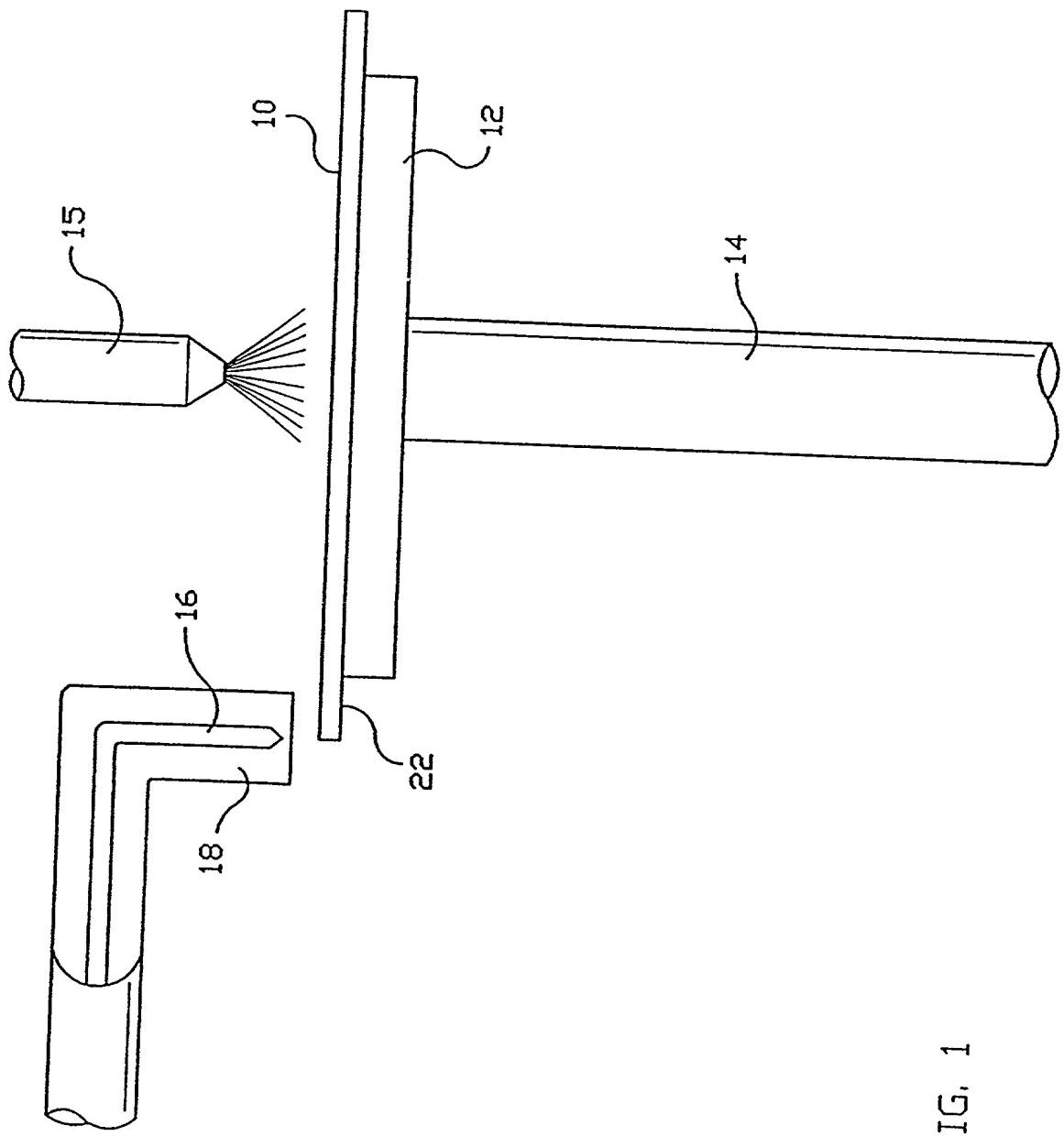


FIG. 1

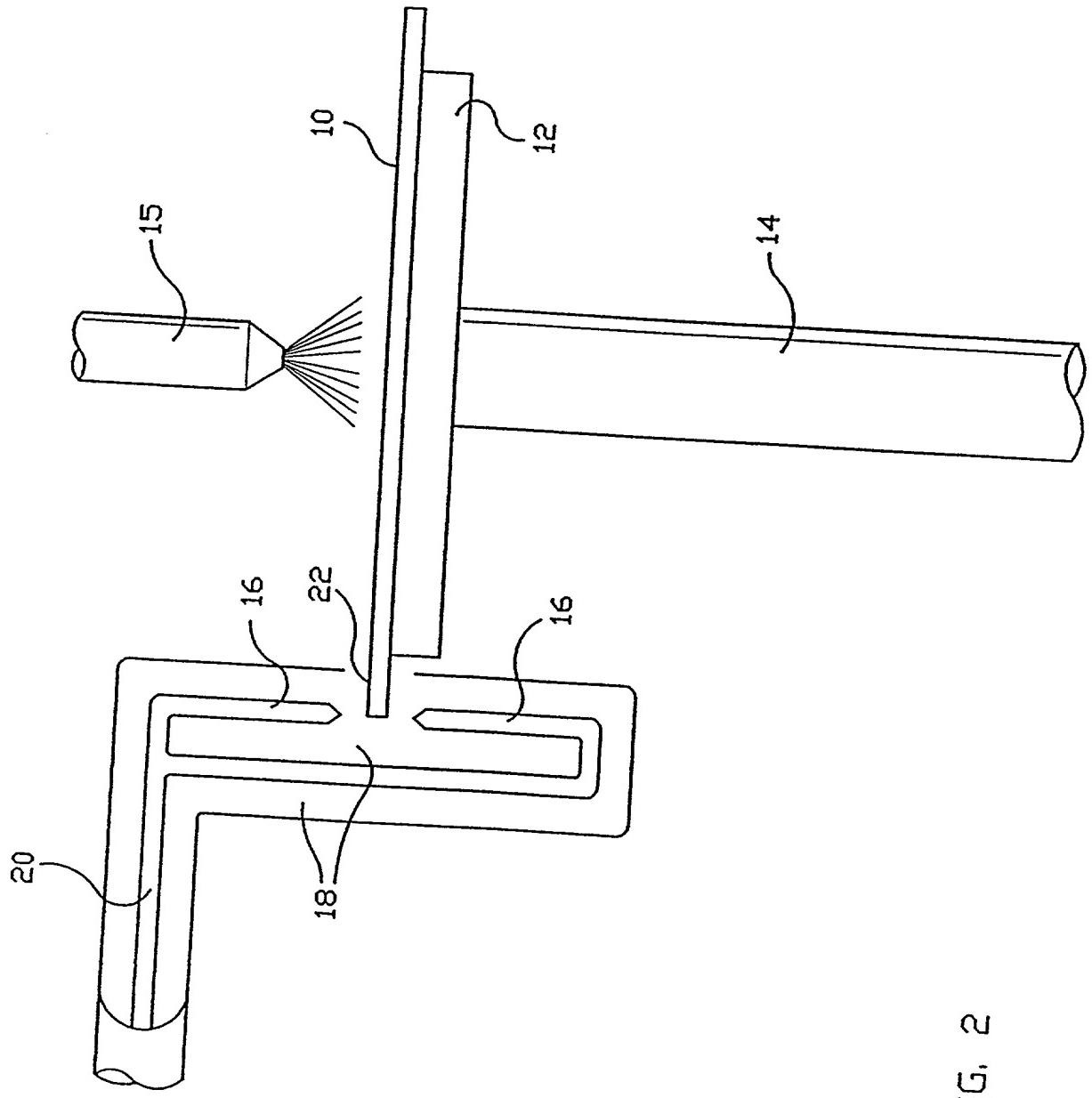


FIG. 2

## **DECLARATION AND POWER OF ATTORNEY**

As below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled; CHEMICAL DISPENSING SYSTEM FOR SEMICONDUCTOR WAFER PROCESSING, specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations Section 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed: NONE.

I hereby claim the benefit under Title 35, United States Code Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code Section 112, we acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application: NONE.

I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As the named inventor, I appoint the following as attorneys to transact all business in the Patent and Trademark Office for this application -- Steven R. Ormiston (Registration No. 35,974), Margaret M. Dunbar (Registration No. 37,818); Craig M. Korfanta (Registration No. 33,255) Bryan Farney (Registration No. 32,651), and Lia M. Pappas (Registration No. 34,095).

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Inventor's Signature: Trung T. Doan Date: 2/20/96

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Country of Residence: Boise, Idaho, 83712 United States of America

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Trung T. Doan

Serial No.:

Filed: August 31, 2000

For: CHEMICAL DISPENSING SYSTEM FOR  
SEMICONDUCTOR WAFER PROCESSING

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ELECTION UNDER 37 C.F.R. §§ 3.71 AND 3.73 AND POWER OF ATTORNEY

Assistant Commissioner for Patents  
Washington, D.C. 20231

Dear Sir:

The undersigned, being Assignee of the entire interest in the above-identified application by virtue of an Assignment recorded in the United States Patent and Trademark Office as set forth below or filed herewith, hereby elects, under 37 C.F.R. § 3.71, to prosecute the application to the exclusion of the inventor(s).

The Assignee hereby revokes any previous Powers of Attorney and appoints: Charles B. Brantley, II, Reg. No. 38,086; Michael L. Lynch, Reg. No. 30,871; Walter D. Fields, Reg. No. 37,130; Kevin D. Martin, Reg. No. 37,882; and David J. Paul, Reg. No. 34,692 as its attorney or agent, with full power of substitution and revocation, to prosecute the application, to make alterations and amendments therein, to transact all business in the Patent and Trademark Office in connection therewith, to receive any Letters Patent, and for one year after issuance of such Letters Patent to file any request for a certificate of correction that may be deemed appropriate.

Pursuant to 37 C.F.R. § 3.73, the undersigned duly authorized designee of Assignee certifies that the evidentiary documents have been reviewed, specifically the Assignment to MICRON TECHNOLOGY, INC., referenced below, and certifies that to the best of my knowledge and belief, title remains in the name of the Assignee.

Assignment:

Filed concurrently herewith for recording, a copy of which is attached hereto.

X Previously recorded on: 2/27/96, at Reel: 7995, Frame: 0626

Please direct all communications as follows:

Charles B. Brantley, Mail Stop 525  
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Boise, ID 83716-9632  
(208) 368-4557

ASSIGNEE: MICRON TECHNOLOGY, INC.

Date: 8-28-00

By:

Michael L. Lynch, Reg. No. 30,871  
Chief Patent Counsel